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ABSTRACT

This paper provides strategies and insights that should be weighed and perhaps included in any proposal for integrating computers into a comprehensive school curriculum. The strategies include six basic stages: Initiation, Needs Assessment, Master Plan, Logistic-Specifics, Implementation, and Evaluation. The New Brunswick (New Jersey) Public Schools District serves as a model which provides examples in describing each stage. Initiation begins by recognizing a need which can start at any level of the educational structure through direct or indirect sources. The Needs Assessment considers curriculum, personnel, training possibilities, hardware/software, computer usage for various departments, support and cooperation of individual department leaders and staff, and awareness of what is available and what other school systems are using. This stage should result in the development of a rationale for a very general proposal based on an assessment of board/community support and monetary status; a committee that represents different levels of the educational community will better be able to provide input and support for the proposal. The Master-Plan involves the committee's evaluation of the rationale and assessment as a basis for more detailed planning and should establish the philosophy, policies, and who is in charge, as well as dividing the stage into smaller units. Logistics-Specifics addresses the components of training needs, curriculum development, hardware/software needs, evaluation, facilities, funding, and scheduling in more detail. Implementation involves the essential ingredients of coordination, supervision, and formative evaluation. Evaluation occurs continually once the plan has been implemented, using such tools as questionnaires, observations, interviews, documentation review, and tests. (DJR)

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FITTING COMPUTERS INTO THE CURRICULUM

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FITTING COMPUTERS INTO THE CURRICULUM

Now that the educational community has wrestled with the inclusion of computer literacy into the curriculum, what's next? Is it realized that the move to include working with computers does not meet the criteria of a "fad" like many skeptics thought? Have we created a new "discipline" or course of study? Do we have a new "tool" which we can now include in our arsenal for problem solving?

Many states are gearing up to have "computer literacy" requirements for graduation. Bills are being introduced at both the state and national levels to create laws and subsequent funding to provide more computers in the schools. Although enrollments in courses dealing with programming are beginning to level off, the ever expanding technology appears to be here to stay. The need to live with this technology and to use it to our advantage is a reality that we will continue to experience.

One of the major objections to include anything more involving computers is the concern that there is just no more room to add new topics to a seemingly saturated curriculum. However, if we accept the computer as an efficient problem-solving tool, we must stop thinking in terms of adding the use of computers as an additional, detached course of study. The use of the computer can be applicable to many traditional curricular topics as a methodology. This approach is consistent with the current demands to "integrate" the computer into existing courses of study.

Henry Becker's 1983 Johns Hopkins University Survey "How Schools Use Microcomputers" found that the percentage of teachers reporting usage of microcomputers for problem solving to be less than 30%. The Association for Supervision and Curriculum Development's Summer 1985 issue of "Update" has the lead story: "Computer Integration into Instruction is Stuck; Experts Blame Unclear Optimal Uses and 3 Implementation Problems." (Those 3 problems were stated as: Hardware accessibility; untrained, inexperienced teachers; and software limitations.) A recent study for the National Commission for Employment Policy by Education Turnkey Systems, Inc., as reported in the NASSP's September 1985 "School Teach News", says that 80% of the public schools have failed to plan for effective use of computers. MIT Computer Scientist and serious critic of the computer revolution in the schools, Joseph Weizenbaum, in an interview for the November/December issue of Classroom Computer Learning, regarded putting so many computers in so many classrooms as a "dangerous and reckless" act. MIT/Harvard's Judah Schwartz said at the October, 1985, Harvard Institute on Evaluation - Uses of Computers in Schools: "It would be a serious educational and tactical mistake if we walk away from implementation into the total curriculum." The Newark Star-Ledger Education Editor recently suggested that schools should put a moratorium on computer expenditures and develop a solid plan for their use. And the debates and theories go on and on. So it looks as if the direction for integrating computers into the curriculum is as disparate as it was for computer literacy.

The common thread in all these debates and proclamations seems to center primarily on one issue: the need for sound, yet visionary "PBPO" - Planning Before Purchase Orders. There are so many variables: humanistic, political, technological, and financial that it is impossible to have a single game-plan or model to follow. We would like to provide some creative ideas, stategies, and insights that should be weighed and perhaps included in any proposal for "fitting" computers into a comprehensive curriculum that takes advantage of modern technology.

Although various strategies and ideas do not fit neatly into a "model", we will try to organize them into 6 basic stages: Initiation, Needs Assessment, Master Plan, Logistics-Specifics, Implementation, and Evaluation. It is important to note that these stages overlap in terms of timelines and personnel. That is, some people may be involved in more than one stage, and others perhaps in just one stage. One stage may not wait for another to be completed fully. Coordination and cooperation between the stages and the various personnel is what determines the success of the effort.

Initiation Stage

The initiation stage is what the name implies - the beginning. Someone has to feel that something needs to be done. Someone has to "produce the seed" - to have the idea that something different needs to be done. This can start at any level of the educational structure: teacher, supervisor, administrator, or Board. It could also be started by students

or parents working through one of the previously named possible initiators. Other considerations are indirect sources of change prompting such as new legal mandates, monetary windfalls, industrial grants/partnerships, new technology, population changes, new administrators, educational trends and research findings, etc. For example, our district is currently planning for a restructuring of grades 6 through 9. So, we have the impetus for change. The time is ripe if the rationale is worthy.

We are putting together a new proposal that will provide more opportunities for students to experience computer applications in the curriculum. The plan calls for 6th graders to have 45 days of keyboarding, taught by Business Education teachers, in a room of electric typewriters that otherwise would no longer be used. Seventh grade students would receive a semester of Computer Literacy/Introduction to Programming Structure.

Due to the logistics, one half of the class population would receive instruction during the first semester, the other half during the second semester. Since the "lab" room would be free either 1 or 2 periods per day, the students not currently enrolled in the computer literacy course would, on a rotating basis, come to the "lab" to complete a series of 9 "applications" assignments. The computer literacy curriculum would "absorb" these same 9 assignments for the students currently enrolled. These assignments are to be developed by the various departments as integral parts of their curricula. Initially, word processing may dominate until the other departments develop "good fits." Furthermore, the collection of

"applications" can be continually expanded and maintained to allow for differentiated tasks.

During the second semester, students change positions. Those students who have now completed the computer literacy course will return, on the rotating basis, for a new series of 9 assignments. In this manner, every student will have computer access at least once every 2 weeks for the entire year.

One teacher will be allowed to report later than normal (2nd period) and supervise an after-school lab for students needing extra time and/or make-up time.

Needs Assessment

Beginning with an evaluation and inventory of what already exists, the next step is the obvious: a needs assessment. This should include: curriculum, personnel, training possibilities, hardware, and software. In our district, a high school goal for this year is to "determine if, and to what extent, computers should be used in each department." This determination involves the supervisory staff in each discipline meeting with the computer supervisory staff to discuss what each department does now, who could use the computer, and what is available.

It is here that one finds out that other department leaders may not be well informed as to what computers can do in general as well as in their area. Language Arts leadership must be knowledgeable about word-processing, Social Studies about data bases and computer searches, and Business Education about spreadsheets. And if they do not, the needs assessment must include this. It is important to note that support

and cooperation of the individual department leaders and staff will be needed in all future stages. It is also wise to consider that the degree of involvement of the various departments will not and does not have to be the same.

Another consideration in this stage is awareness of what is available and what others are doing. Reading and investigating is more effective than trusting salespeople promising more than they can deliver. Awareness of such technologies as 32 bit machines, laser printers, satellite dishes, communications/data bases, interactive video, and digital TVs is essential in doing a needs assessment and any further planning. For example, our district has initiated a survey of the members of an existing state-wide consortium (NAME-Network for Action in Microcomputer Education) on how the school systems are using computers in the various disciplines found in the educational structure.

We have been considering the use of computers in drafting classes. One supervisor is proposing Apple IIe/CAD Apple stations that have been demonstrated to meet the needs. Another supervisor advocates the use of the Apple Macintosh. The survey has provided us with the knowledge of a district that has a 10 Macintosh lab used for drafting. A visitation has been planned to see this arrangement in action, not a salesperson's demo. Again, we can benefit from the experiences of others.

The needs assessment should develop the rationale for a very general proposal. Without a solid rationale, the process should, and probably will, end here. It is also here that a proponent needs to assess board/community support and monetary status.

If a proposal has advanced this far, it is time to start generating the master plan. A committee may be best suited so that the proposal wouldn't end if one person does not proceed. Also a committee that represents different levels of the educational community will better be able to provide input and support for any proposal.

Master-Plan Stage

The first action of the committee would be to evaluate the rationale and assessment to determine whether the more detailed planning should continue. If the proposal is continued, the master-plan should establish philosophy and policies, establish who is in charge of this stage, and divide the task into smaller components. It is important to establish who is doing what and a tentative timetable. Nothing is worse than to have everyone waiting for each other to make the next move.

The individual components could include staff training needs, curriculum development, hardware and software needs, evaluation, facilities, funding, and scheduling ramifications.

Logistics-Specifics

Each of the above components should now be addressed in more detail. The training of staff is very crucial. As noted earlier, this is often mentioned as the common weak link in implementations. Current staff members can be trained without the need of hiring all new people. If the intent is to integrate use of the computer into the other departments, then the personnel already in place can best make things "fit." For example, our Computer Studies Department has included teachers

from Math, Science, Foreign Languages, Elementary, Language Arts, Special Education, and Music. Interestingly, foreign language teachers may make good programming teachers as well, since much of programming is to serve as an interpreter between thoughts and a particular language. Along the same lines, musicians must also deal with combining creativity with the rules and structures of music. A feasible, cost effective method is to have teachers spend time in existing classes as students. For example, in our district we currently have a foreign language teacher serving as a "student teacher"in a Computer Literacy class. A Special Education teacher teams with a Computer Studies teacher to provide instruction to Resource Room students. This Special Education teacher previously participated as a student as part of his training. At the high school, a math teacher has now spent one semester in Pascal, and is currently "taking" BASIC during his plan time. Another math teacher has made a commitment to take BASIC second semester. Perhaps administration can encourage this technique to those who are interested by replacing teachers on "cafeteria duty" or "hall duty" with non-professionals. Of course, such extra expenses need to be considered in the total cost of the project.

Curriculum planning is crucial if we insist on making the use of the applications "fit" the existing or a slightly modified curriculum. Both supervisors and teaching staff need to be involved. Time and financial remuneration must be considered and analyzed.

Some insights and suggestions as to where the use of the computer could "fit" into existing or slightly modified curriculums will now be exposed.

In meeting with department supervisors in our district, the area with the highest degree of interest is the Industrial Arts area. Drafting will soon be done with either CAD stations or Apple Macintoshs with MacPaint, MacDraw, MacDraft, etc. The only questions are when and how, no longer if. Robotics and a computer controlled lathe are under strong consideration and investigation. Computerized auto analysis is also under consideration. Printing and commercial art can be done with a Macintosh and a laser printer. In a recent ad in the "Teacher/School Employment Opportunities" section of a regional paper, the following opening for a high school position appeared:

> "Computer Electronics - advanced electronic background in circuitry, dealing with digital lab equipment, logic trainers, and microprocessors."

Numerous simulations are available to expose students to new technology where funds do not permit purchase of actual equipment. In an area that provides hands-on experience with equipment, it's natural to upgrade equipment and techniques as technology advances.

The use of the computer "fits" into many areas in science. Our biology classes use the computer for data storage and analysis(including graphing) across sections and schools in the district. Two areas under consideration at this time are to do data analysis in physics and telecommunications/data bases for seminars in scientific research. Classes in meteorology

could also retrieve data directly from the Weather Bureau. There are enormous numbers of CAI packages covering almost every area in science. Simulations are now becoming better in terms of quality of the graphics and the open-endness of what the user can do.

The Business Education Department currently has a word-processing lab (of dedicated word-processors) that mainly attracts the same students that normally would have advanced up the ladder in typing. Having more terminals and open access would allow the students to use this as a means of preparing their assignments. Accounting and bookkeeping should include the use of a spreadsheet. Office practices should include electronic bulletin boards, electronic mail, data bases and reports, graphics, and construction of presentations. Typing skills can also be enhanced with "games" such as MasterType.

Mathematics, the area in which many schools place their computers, also can use the computer in many ways. Basic skill development and remediation can be both effective and efficient. Simulations can be effective in geometry, trigonometry, and graphing. Number crunching, both by a spreadsheet and by programming, can be an efficient way to teach such courses as probability and statistics, as well as calculus.

Use of the computer for wordprocessing can have a substantial impact on the methodology of teaching composition. The ease of making modifications can provide students with the opportunity to spend their time more effectively in the creation stage than previously, when a single modification could

mean a complete rewrite. With easier editing, better writing can be expected. Spelling checkers can be helpful, as can grammar checkers. The major obstacle in this area is the number of units needed to accommodate the masses. For example, our high school would need 60 units used every period of the day to accommodate all students once a week. Also, extra units would be needed to facilitate independent work.

At first, discussions with the Social Studies Chairperson did not yield many relevant ideas for usefulness in that area, but ended with a great interest in the possibility of data base searches that could afford better research and reports. There is much CAI and simulations (such as the Oregon Trail & Beyond the Rising Sun) available to supplement regular instruction.

In addition to the earlier mention for commercial art, introductory art classes could provide such instruments as Koala Pads, light pens, and mice as well as such software as Delta Draw, DazzleDraw, and MacPaint. Some software can do rotations, perspectives, magnifications, and distortions. These are just new mediums to present one's expressions.

In the area of Home Economics there is a program that analyzes one's diet and makes recommendations regarding what is needed and what has been overconsumed.

Miscellaneous programs such as PRINTSHOP provide students with an easy way to make banners, posters, and greeting cards. Programs such as NEWSROOM and PAGEMAKER allow the students to actually compose and produce a small scale newspaper. This could be incorporated into language arts classes, journalism classes, clubs, and other school activities.

Previous examples and suggestions have all dealt with the use of the computer in various curricular areas. Although one could debate the values of "games", it could be considered that playing certain games could help with game strategy. But the use of the computer could probably be best used in the Physical Education Department for more "administrative" purposes that we have purposely excluded in all other areas. Analysis of performances on such measures as the President't Physical Fitness Test demand the use of the computer to make it a realistic function to perform.

Also, one may possibly find some linkage between increasing SAT scores and increasing SAT preparation software programs.

MIT's Weizenbaum was also quoted as having no objections to applications that are "delivered effectively and sensibly." The first concern is to not try to short circuit the teacher/student relationship. The human component is one of the most important aspects of the educational process. Secondly, simulations can be fascinating, effective, safe, and cheaper than the real thing. But in this age of declining use of our hands, don't substitute the computer where the real thing is feasible. Thirdly, we all spent too much time watching a CRT - TV.

In terms of hardware considerations, in addition to the variety of equipment on the market, we may also have to deal with existing hardware. Can we use it, or do we need to replace it? Some of the older machines have limited capabilities, and finding good software is more limited than with some newer machines.

At our high school, we have 60 terminals connected to a minicomputer. As replacements become necessary, we are exploring the use of microcomputers that can work both as a dumb terminal and as a microcomputer. Network arrangements have now reached a level of sophistication that different types of computers can be networked together and share a common database. According to a recent article in the New York Times, Apple has defined this aspect as their top priority. These networks can also use telephone lines and connect computers in different buildings, different districts, different states, different countries, etc. They could also be accessed by home-bound students. In this area, the advances of the technology have left most districts in a state of indecision, weighing the positive aspects of home-bound instruction to the negative aspect of illegitimate access and abuse.

Don't overlook the considerations for additional space requirements, installation expenses, time, maintenance, and service. Maintenance and service could become the basis of future course offerings in the Industrial Arts field. The debate over a few computers in every room or a few "labs" will continue.

The concern of funding is very important since new programs and equipment cost literally thousands of dollars. Budgetary increases are discouraged in light of declining enrollments, a graying population, and a sense of overtaxation.

The concern that equipment from previous expenditures have ended in obsolescence so quickly is an ever present hurdle. On-going expenditures for computers need to be accepted as we have accepted on-going textbook expenditures.

Implementation Stage

Contrary to many beliefs this is not necessarily the most difficult stage. If the planning has taken place properly with cooperation between the different departments and levels of the educational structure has been accomplished, this can be the stage that everyone is waiting for with anticipation and eagerness. Coordination, supervision, and formative evaluation are essential. Revisions and modifications can easily accepted as "normal" and dealt with to improve upon the original plan on an on-going basis.

Evaluation

Formative evaluation occurs continually once the plan has been implemented. Evaluation tools can include: questionnaires (a good way to get a large amount of data quickly), observations (time consuming but usually more specific), interviews, documentation review, and tests. Monitoring of the implementation should lead to a summative evaluation that usually leads to a new needs assessment and further evolution of the curriculum. For example, our district now has an excellent line-up of programming courses (2 levels of BASIC, 3 levels of Pascal, FORTRAN 77, COBOL, and C) and a system that is performing to our satisfaction. And, there is the capacity to expand in the area of applications. An integrated computerized office environment with wordprocessing, data base,

report generator, spreadsheet, graphics, and electronic mail is available. We are now beginning to plan how this potential can be converted into reality that takes this technology and "fits" it into the curriculum.

The stategies and insights we have shared should be considered in integrating the use of computers into a comprehensive curriculum that takes advantage of modern technology. Most of us are ready for this step as a result of an evolution into computer literacy and now beyond. We need planning, coordination, cooperation, refinement, and supervision to continue toward our dreams of excellence in education.